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STATE GEOLOGICAL SURVEY DIVISION
John C. Frye, Chief

GUIDE LEAFLET

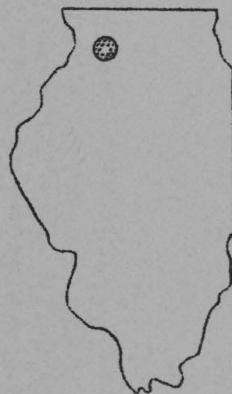
GEOLOGICAL SCIENCE FIELD TRIP

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DIXON AREA

Lee and Ogle Counties

Dixon Quadrangle



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Leaders
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Introduction

The Dixon area is situated in the southern part of the Rock River Hill Country, a scenic region of gently rolling, glaciated uplands. The undulating topography reflects the irregularities of the bedrock surface that is only thinly mantled by unconsolidated glacial deposits. During the Pleistocene Epoch, commonly referred to as the "Great Ice Age," the region was covered by continental glaciers of the Illinoian and Wisconsinan Stages (see attached Pleistocene Time Table). The Illinoian glacial deposits in the Dixon area were largely stripped away by stream erosion during the warm Sangamonian interglacial interval and later by glacial erosion during the advance of the Early Wisconsinan glacier. The only evidence of the Illinoian glaciation comes from deep water well borings in buried bedrock valleys such as Ancient Rock River Valley, where patches of Illinoian deposits are preserved beneath the younger Wisconsinan drift. The Wisconsinan glacier covered the Dixon area during two separate advances--the Altonian (Winnebago) and the Early Woodfordian (Shelbyville). Drifts of Altonian and Woodfordian ages are extensively exposed in the field trip area (see Itinerary Map and map of Glacial Geology of Northeastern Illinois). The last glacial ice melted from this area about 17,000 to 18,000 years ago.

Beneath the glacial drift the Dixon area is underlain by approximately 3,700 feet of Ordovician and Cambrian sedimentary strata consisting of limestone, dolomite, sandstone, and shale (fig. 1). These rocks were laid down layer by layer in the ancient seas that covered Illinois and the Midwest during the early part of the Paleozoic Era between about 550 to 450 million years ago. The upper 1,000 feet of these rocks down to the Cambrian Franconia Formation are exposed in the field trip area. Approximately 2,700 feet of older Cambrian rocks are known only from deep drill holes. The base of the Cambrian rocks rests upon an ancient basement of Precambrian igneous and metamorphic rocks more than one billion years old. Paleozoic strata younger than those exposed in the field trip area occur to the west, south, and north (fig. 2 and Geologic Map of Illinois).

Geologically the Dixon area is situated along the northern margin of the Illinois Basin, a large, spoon-shaped depression underlying most of Illinois and adjacent parts of Indiana and Kentucky. The basin is now filled with the Paleozoic sedimentary rocks. Beginning in Late Cambrian time about 500 million years ago the Illinois Basin became a slowly subsiding (sinking) region, and this continued intermittently until the end of the Pennsylvanian Period some 280 million years ago. Southward the Paleozoic rocks thicken to more than ten thousand feet in the deepest part of the basin in extreme southeastern Illinois. Regionally the sedimentary layers are also tilted gently southward into the basin (fig. 2). Toward the north they thin as they rise onto a broad domal uplift known as the Wisconsin Arch in north central Wisconsin. In the central area of this uplift the Precambrian rocks that are deeply buried in the Illinois Basin rise to the bedrock surface and are exposed in many places. The Cambrian strata below the Franconia Formation are also exposed around the margin of the dome.

The Dixon area is one of the geologically complex areas in Illinois, and several interesting structural features including the Ashton Arch, the Sandwich Fault, the Oregon Anticline, and the LaSalle Anticline interrupt the regional southward slope of the strata (figs. 2 and 3). The major structure is the Ashton Arch, a broad, high anticline which extends for 80 miles southeastward from the Rock River, past Ashton (from which it receives its name), into Kendall County.


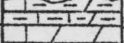
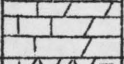
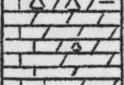
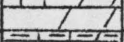
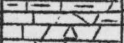
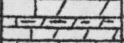

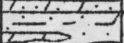
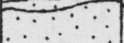
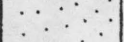
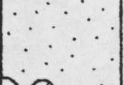

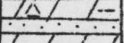
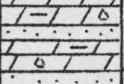
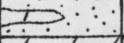
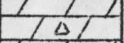
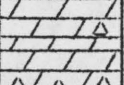
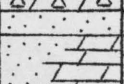

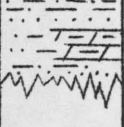

QUAT. SYSTEM	Pleist. Series	GROUP, STAGE	FORMATION	ROCK UNIT	THICK-NESS (feet)	DESCRIPTION
ORDOVICIAN	Champlainian	Wisconsinan			0-200	Outwash (gravel, sand, silt) as valley fill, terrace deposits, eskers; Till
			Dubuque		32	Dolomite, shaly
		Galena	Wise Lake		90	Dolomite, pure massive; Receptaculites in upper half
			Dunleith		125	Dolomite, cherty, abundant receptaculites in zones
			Guttenberg		5	Dolomite, red shale beds
			Quimby's Mill		12	Dolomite - Limestone, clayey
		Platteville	Nachusa		20	Dolomite - Limestone, pure
			Grand Detour		50	Dolomite - Limestone, pure, shaly
			Mifflin		26	Dolomite - Limestone, shaly
			Pecatonica		30	Dolomite, pure
		Ansell	Glenwood		28	Dolomite - Sandstone - Shale
			St. Peter		200	Sandstone, pure; shaly and cherty <u>Kress Member</u> at base
	Canadian	Prairie du Chien	Shakopee		100	Dolomite, cherty, sandy
			New Richmond		30	Sandstone, dolomite beds
			Oneota		150	Dolomite, cherty
			Gunter		25	Sandstone
			Eminence		25	Sandstone - Dolomite
CAMBRIAN	Croixan		Potosi		85	Dolomite, small quartz geodes
			Franconia		90	Sandstone - Dolomite - Shale
			Ironton Galesville Eau Claire		600	Sandstone - Dolomite - Shale
			Mt. Simon		1950	Sandstone, gravelly
						Granite; igneous and metamorphic rocks

Fig. 1 - Generalized Geologic Column - Dixon Area



Fig. 2 - Generalized geologic map of north central Illinois. Cross section along line A-B crosses the Ashton Arch and the Sandwich Fault Zone.

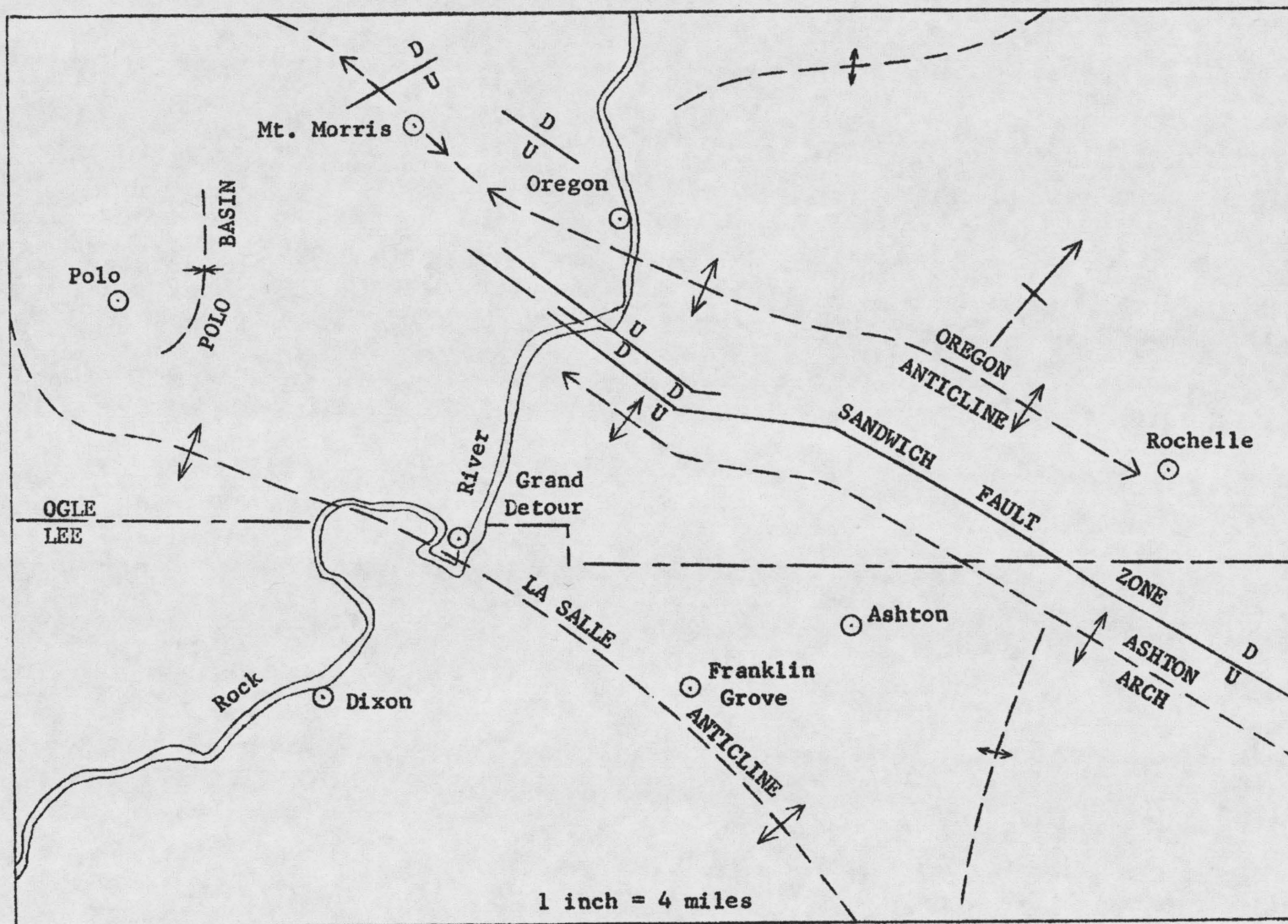


Fig. 3 - Major structural features of the Dixon-Oregon area

The Cambrian rocks rise to the bedrock surface along its crest, providing the only exposures of these ancient rocks in Illinois. Along its northern flank the Ashton Arch is bounded by the Sandwich Fault, a major zone of fracturing along which the strata on the north side have moved down relative to the strata to the south.

The bulk of the Cambrian and Ordovician strata exposed in the Dixon area consists of limestone and dolomite that provide the basis of the area's mineral industry. Ordovician limestone is quarried at Dixon for the manufacture of cement. Crushed limestone and dolomite are also produced for use as roadstone, concrete aggregate, and agricultural lime (agstone). The glacial deposits of the area are important sources of sand and gravel for the building industry. The pure quartz sandstone of the Ordovician St. Peter Sandstone is an important source of silica sand for the glass and ceramics industry, and is being extensively quarried in the vicinity of Oregon.

Glacial History of Illinois

Thousands of years ago much of northern North America was covered by huge glaciers. These glaciers, which advanced from centers in eastern and central Canada, developed when the mean annual temperatures were a few degrees lower than they are now, and the winter snows did not completely melt during the summers. After many years a sheet of ice accumulated that was so thick its weight caused it to flow outward, carrying with it the soil and rocks on which it rested and over which it moved.

The Pleistocene Epoch or "Great Ice Age" began about one million years ago and ended about five thousand years ago. During this epoch, there were four major stages of glaciation, each followed by a long interglacial stage characterized by climatic conditions much as they are today (see diagram on next page and attached Pleistocene Time Table in back of guide leaflet).

The oldest glacial stage is the Nebraskan, named after the state of Nebraska where extensive Nebraskan deposits are buried beneath the younger glacial deposits. In Illinois the Nebraskan deposits are also buried, and there are only rare exposures of Nebraskan till in extreme western Illinois. A warm climatic interval, called the Aftonian (interglacial) Stage, followed the melting of the Nebraskan glacier.

The next glacial climate produced the Kansas glacier, which left thick deposits of fine rock materials and outwash sand and gravel in Illinois when it melted away. The Kansan Stage was followed by the Yarmouthian (interglacial) Stage. During this stage, erosion carved valleys and hills, and soils were formed in the Kansan deposits.

The third glacial stage, the Illinoian, is particularly important to the residents of Illinois. The Illinoian glacier, in three separate advances (Liman, Jacksonville, Buffalo Hart), covered 80 percent of the state, reaching southward to Carbondale and Harrisburg. After several thousand years, a warm stage caused the Illinoian ice sheet to melt. During this warm stage, the Sangamonian, the upper part of the deposits left by the glacier was weathered and soil developed, as in the preceding Yarmouthian interval. These ancient Sangamonian soils resemble present-day soils in color, texture, and depth, suggesting that the climate during interglacial times was similar to our present climate.

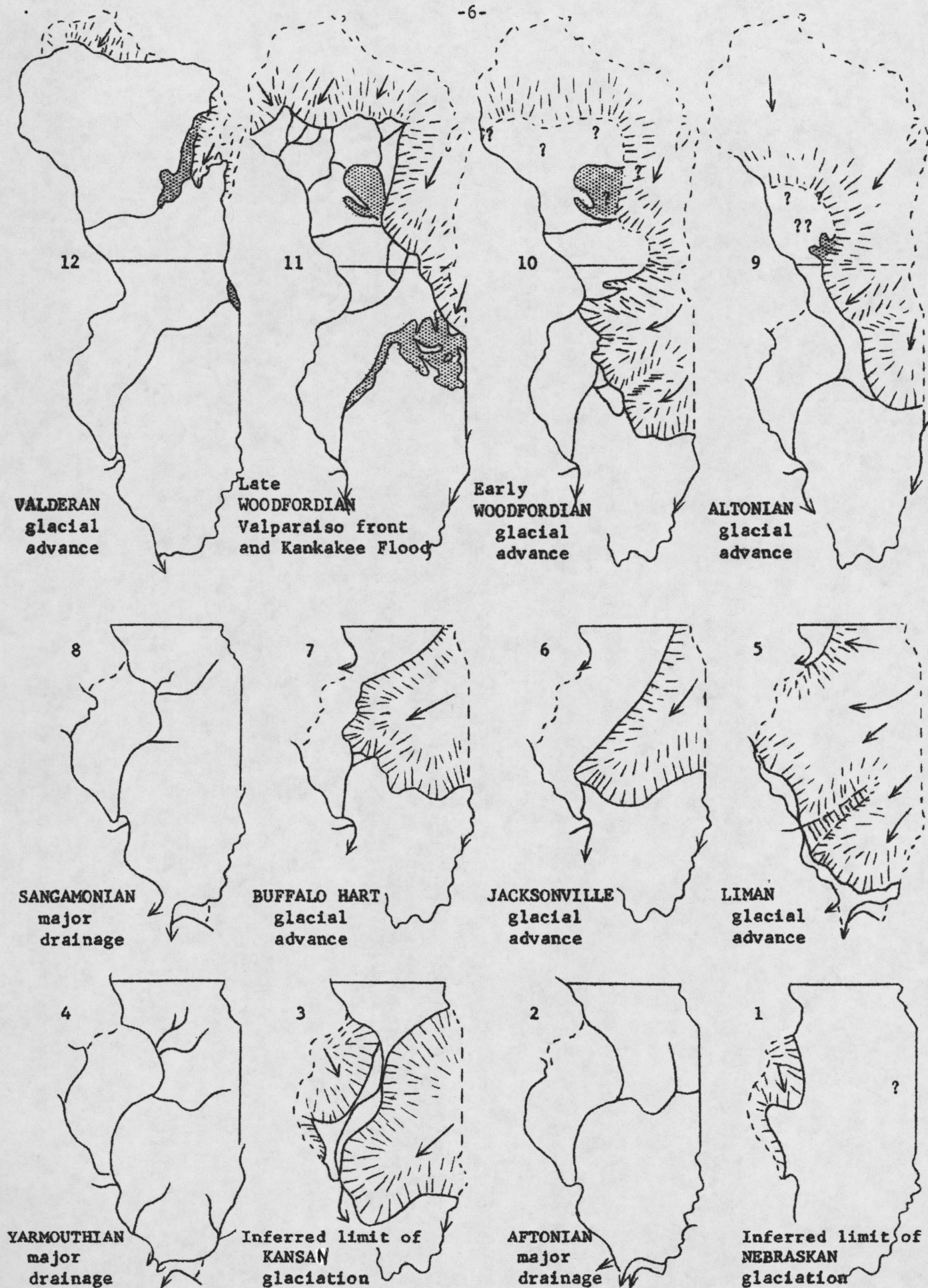


Figure 4. Pleistocene glacial and interglacial intervals in Illinois

The last and most recent glacial stage in Illinois was the Wisconsinan, which began about 70,000 years ago. The Wisconsinan comprised three major glacial advances—the Altonian, the Woodfordian, and the Valderan. Little is known about the extent of the Altonian glacier, as its deposits were overridden by later glaciers, except in northern Illinois. The Woodfordian glacier advanced southward from the Lake Michigan basin to the present sites of Shelbyville, Decatur, Charleston, and Peoria. The Valderan glacier reached its maximum extent near Milwaukee, Wisconsin, and did not enter Illinois.

When the glaciers melted, they released the rock materials they had picked up as they advanced. These materials are called glacial drift. Glacial drift deposited directly by the ice is called till. It is unsorted and unstratified and consists of a mixture of all kinds and sizes of rock fragments. As the Wisconsinan glacier wasted away, the ice front melted back and readvanced many times, creating a complex sequence of till deposits in northeastern Illinois, the most outstanding of which are end moraines. More than 50 successive end moraines were formed by the Wisconsinan glacier in Illinois alone. The major ones are shown on the accompanying glacial map of northeastern Illinois.

Some of the glacial drift was washed out with the meltwaters and is called outwash. Outwash is layered or stratified. The coarsest material (gravel, sand) carried by the meltwater was deposited nearest the ice front, and the finer material (silt, clay) was carried farther away, with some possibly carried all the way to the sea. Where the outwash was spread widely along the front of the glacier, it formed an outwash plain. Where the outwash was restricted to the stream valleys, it formed valley train deposits. Many valley trains in Illinois are buried beneath younger glacial drift.

An end moraine is an accumulation of drift at the ice margin when the rate of advance and the rate of melting of a glacier are essentially in balance. As more and more rock debris is brought to the edge of the glacier, it piles up and forms a ridge.

The surface relief of end moraines is generally greater than that of the surrounding area and is referred to as swell-and-swale or knob-and-kettle topography. At some places there are large gaps in the moraines where subglacial streams presumably carried away most of the drift. The flatter areas behind end moraines are called ground moraines or till plains.

At times, especially in the fall and winter, the meltwaters subsided, exposing the valley trains. The wind picked up silt and fine sand from the floodplains and dropped these materials on the bluffs and uplands to form deposits of loess. Loess mantles most of Illinois. Near the large river valleys it may be as much as 60 to 80 feet thick, but it thins rapidly away from the valleys.

The importance of the Pleistocene Epoch to Illinois is emphasized by the rich soils formed from the glacial deposits and by the abundant deposits of sand and gravel. The glacial outwash, especially buried valley trains, is an important source of ground water. The state would not have these valuable resources if the glaciers had not invaded Illinois.

Itinerary

- 0.0 0.0 Assemble at the southeast corner of Dixon High School on Lincoln Statue Street. Turn right and head south on North Peoria Avenue across the bridge over Rock River.
- 0.2 0.2 Unguarded railroad crossing. CAUTION
STOPLIGHT. Continue ahead across First Street.
- 0.1 0.3 STOPLIGHT. Cross Second Street.
- 0.1 0.4 FOUR-WAY STOP. Cross Third Street.
- 0.3 0.7 FOUR-WAY STOP. Turn left (east) on Seventh Street.
- 0.1 0.8 FOUR-WAY STOP at Galena Avenue. Continue straight ahead on Routes 30 and 52. Stay in left lane.
- 0.4 1.2 Intersection of Routes 52 and 30. Bear left (east) on Route 30.
- 0.3 1.5 Dixon City limits. Continue ahead (east) on Route 30.
- 3.2 4.7 T-road intersection from left. Continue ahead.

The highway follows the boundary between the Winnebago drift and the Shelbyville till sheet (see Itinerary Map).

The Shelbyville margin is generally marked by a prominent end moraine south of Peoria (see map of Glacial Geology of Northeastern Illinois). In the Dixon area the Shelbyville ice was thin, probably only a few hundred feet thick. As a result the Shelbyville till deposits are also thin. The ice stagnated (stopped moving) soon after it reached its maximum extent, and no end moraine was formed. The margin of the glacier has been determined by studying the distribution of the Shelbyville till in exposures and in borings.

- 1.0 5.7 Crossroads with Nachusa Road. Continue ahead.
- 0.1 5.8 Nachusa Lutheran Home on right.
- 1.0 6.8 Crossroads. Continue ahead (east).
- 1.1 7.9 SLOW. Prepare to turn left.
- 0.2 8.1 Turn left (north) on gravel road.
- 1.4 9.5 T-road from right. Continue straight ahead.
- 0.5 10.0 Cross Franklin Creek.

Stop 1. Exposure of Middle Ordovician St. Peter Sandstone. The sandstone is well exposed along the north bank of Franklin Creek. DO NOT CLIMB ON THE FENCES.

The St. Peter Sandstone is of special interest geologically because of its widespread distribution and its remarkable high purity. The St. Peter occurs over a vast area of the Midwest stretching from northern Michigan to Kentucky and from Kansas to Ohio. Principal areas of exposure in Illinois are in the Dixon-Oregon area and the Ottawa-LaSalle area, where the Middle Ordovician rocks are brought to the bedrock surface along the flanks of the Oregon Anticline and the Ashton Arch. The St. Peter forms high bluffs along the Illinois River at Starved Rock State Park. Outside of these areas the St. Peter has been penetrated in the subsurface by many wells. Except where it has locally been removed by erosion, the formation underlies almost the entire state.

The St. Peter Sandstone is a remarkably pure, fine-grained sandstone consisting of well-rounded grains of quartz. Many of the grains exhibit a peculiar frosted or dull appearance. The sandstone also exhibits well-developed inclined laminations called cross bedding. On many exposures the sandstone is light gray to pure white in color, giving the formation a distinctive appearance, but commonly it is slightly brownish in color because of staining by iron oxide. The sandstone is typically friable (loose) and soft, exhibiting a sugary texture, and is easily disaggregated in the hand. In the subsurface the St. Peter is sometimes tightly cemented by calcium carbonate, suggesting that its loose texture has been produced by the removal of the cement by weathering and by leaching by percolating groundwater.

The origin of the St. Peter Sandstone has interested geologists for a long time. An early theory suggested that the sandstone was deposited on the land in a vast interior desert of drifting dune sand. Similar cross bedding, roundness, and frosting are found in sands of present day deserts, such as the Great Sahara Desert of North Africa. The rounding and frosting is caused by the grains striking each other as they are moved along by the wind. Today most geologists believe that the St. Peter is a marine deposit. All of the properties of the sandstone can be explained as the products of wave and current action in a shallow sea. Beds of marine limestone are present in the middle and upper parts of the formation in extreme northern and southwestern Illinois, Iowa, Arkansas, and Oklahoma. Marine fossils occur in some of the limestone beds, and although extremely rare, in the sandstone as well. The sand was derived principally from Precambrian igneous and metamorphic rocks in south-central Canada and transported southward by streams into the Middle Ordovician sea. Conditions in the sea remained very stable for a long time, and the sands were extensively reworked by waves and currents which wore away the less resistant mineral grains and removed the muddy sediments, leaving behind the well-sorted, well-rounded, highly resistant quartz sand. As the quartz grains were moved along the sea bottom by currents and washed back and forth by waves, they gradually became rounded and frosted. Cross bedding in the St. Peter Sandstone also indicates a high energy, agitated environment, and more strongly resembles cross bedding exhibited by known marine sandstones, rather than that found in dune sands. Some shifting of the St. Peter sands probably occurred in dunes along the shoreline of the St. Peter sea, similar to that occurring along present day shorelines. These dune sands were later eroded and incorporated into the marine deposits as the sea advanced toward the north.

The contact between the St. Peter Sandstone and the older sedimentary rocks upon which it rests is a major unconformity or erosion surface throughout the Midwest. After deposition of the Lower Ordovician strata, crustal movements raised the Midcontinent region above sea level, and a long interval of erosion accompanied by widespread development of solution features (karst topography), cut

deeply into the underlying rocks. There is evidence that a river system drained across northern Illinois from the northeast and cut deep channels into the bedrock. All of the Shakopee and New Richmond Formations and much of the Oneota Dolomite were stripped off the crest of the Ashton Arch (figs. 1 and 2). Erosion also cut into the Cambrian rocks. North of the Ashton Arch in northern Illinois and southern Wisconsin the Lower Ordovician strata were completely removed from the flanks of the Wisconsin Arch in many places. The erosion interval ended when the Midcontinent region was lowered below sea level again.

When the Middle Ordovician sea advanced over the Midcontinent, the clean, well-sorted St. Peter Sandstone was deposited on the erosional surface of Lower Ordovician and Cambrian rocks (figs. 1 and 2). The sandstone is generally less than 200 feet thick, but where the sand filled ancient ~~river~~ river channels, it is locally as much as 500 feet thick. Recently Survey geologist T. C. Buschbach presented evidence that some of the unusual thicknesses of sandstone were deposited in large sinkholes rather than in river channels. The sinkholes were formed by the solution of the Lower Ordovician limestones by percolating groundwater during the pre-St. Peter erosion interval.

The St. Peter Sandstone is a valuable source of silica sand to the state of Illinois, as well as to the nation. It is world famous as a glass sand, but it is also used as molding sand (foundry sand), abrasives, in the manufacture of silica brick, ceramic glazes, and ferro-silicon, and for a score of other uses. The oil industry uses the sand in the fracture treatment of oil-bearing formations to increase the flow of oil through the rocks. Illinois ranks first in the production of glass sand in the United States, almost all of it coming from the St. Peter Sandstone in Ogle and LaSalle Counties. The production of silica sand in Illinois in 1965 totaled 3,361,000 tons valued at \$11,991,000.

0.0 10.0 Leave Stop 1. Continue ahead

0.7 10.7 T-road intersection. Turn right (east).

0.2 10.9 Stop 2. Exposure of Winnebago drift in roadcut along right side of road.

Rock debris or drift that was deposited directly by glacial ice is called till. The till exposed here was deposited by the Altonian glacier about 50 thousand years ago and is part of an extensive layer of drift exposed in northern Illinois known as the Winnebago drift. The Altonian drift has been named Winnebago because of its wide distribution and good exposures to the north in Winnebago County. The younger Shelbyville drift occurs on the slope above.

The Altonian glacier advanced westward and southwestward across northern Illinois from the Lake Michigan basin and the Green Bay Lowland (fig. 4). In the Dixon area the glacier extended past Dixon as far as Sterling in western Whiteside County. After reaching its maximum extent the glacier soon stagnated and began to melt. Much meltwater was produced, and as a result the Winnebago drift contains much outwash. Exposures of the drift commonly include till containing beds and lenses of sand and gravel. Much outwash was also deposited in the Ancient Rock River Valley and its tributaries.

Till consists of an unsorted mixture of boulders, pebbles, sand, silt, and clay, and is typically unstratified or non-bedded. Note the wide range of particle sizes and the sandy, stony character of the till in this exposure. The till contains a large variety of different kinds of sedimentary, metamorphic, and

igneous rock fragments eroded from the bedrock over which the glacier moved. Much limestone and dolomite derived locally from the Ordovician and Cambrian formations and from the Silurian dolomites of the Chicago region are present. The St. Peter Sandstone directly underlies the drift at this locality and was also eroded by the glacier. This explains the sandiness of the till. The igneous and metamorphic rocks were transported from far to the north in central Canada. Many of the rock fragments are faceted (flattened on one or more sides) and striated (scratched) from having been dragged along the frozen ground by the glacier.

- 0.0 10.9 Leave Stop 2. Continue ahead (east).
- 0.2 11.1 St. Peter Sandstone exposed in road cut on the right.
- 2.4 13.5 STOP. Crossroads. Franklin Grove Road. Continue ahead (east).
- 1.3 14.8 STOP. T-road intersection. Turn right (south).
- 0.3 15.1 STOP. Intersection with Alternate Route 30. Turn left. CAUTION.
- 1.0 16.1 SLOW. Prepare to turn left.
- 0.1 16.2 Turn left (north) on gravel road.
- 1.5 17.7 Stop 3. Active quarry in Lower Ordovician (Prairie du Chien) Dolomite.

The dolomite quarried here is crushed for use as roadstone and agricultural lime. In 1965 commercial quarry operators in Illinois reported a production of 43.3 million tons of crushed and broken stone, which was valued at 57.8 million dollars.

The quarry face exposes about 24 feet of the Oneota Dolomite. The Oneota has a maximum thickness of 150 feet in northern Illinois. The Oneota is slightly cherty, but generally consists of quite pure dolomite. Other features that are characteristic of the Oneota are its coarse texture, zones of irregular pink chert nodules, and numerous small solution cavities (vugs), some of which are filled with green clay. These characteristics distinguish the Oneota from the finer grained, more impure, sandy, and shaly Shakopee Dolomite of the Prairie du Chien Group that will be seen at Stop 7. Fossil collecting in the Oneota is poor because fossils are scarce and poorly preserved. The section exposed here is described below.

	<u>Thickness</u>
Ordovician System	
Canadian Series	
Prairie du Chien Group	<u>Top of Quarry</u>
Oneota Dolomite	
-Dolomite, thin-to-medium bedded, medium to coarse grained, sucrosic, very vuggy, light brown; green shale parting at base of unit	6' 8"
-Dolomite, thick-bedded, fine grained, very vuggy, light gray, brown-mottled; irregular pink chert nodules at top of unit	4' 6"
-Dolomite, medium-to-thick bedded, fine to medium grained, slightly cherty, vuggy, clayey, brownish-gray; thin clay streaks and small pockets of green clay	4' 0"

Oneota Dolomite (Continued)

Thickness

- Dolomite, thick-bedded, medium to coarse grained, gray, brown-mottled; a few gray and pink chert nodules; prominent green shale streak at base of unit 4' 6"
- Dolomite, thin-to-medium bedded, coarse grained, highly sucrosic, gray brown, brown-mottled; thin green clay streak at base of unit 2' 0"
- Dolomite, medium bedded, fine to medium grained, sucrosic, brown; prominent gray chert band near top of unit; thin bands of white and gray chert 3' ±

Bottom of Quarry

Origin of the Dolomites

Most geologists believe that dolomites were originally deposited as limestone by the chemical precipitation of calcium carbonate from sea water and by the accumulation of the calcareous remains of marine plants and animals. At some time after their deposition the limestones were changed or dolomitized to dolomites.

During dolomitization, magnesium ions replace calcium ions in the atomic structure of the mineral calcite (CaCO_3). Based upon the degree of dolomitization, a carbonate rock is classified as limestone (0-10% dolomite), dolomitic limestone (10-50% dolomite), calcitic dolomite (50-90% dolomite), or dolomite (90-100% dolomite). In pure dolomite the calcium-magnesium ratio is about one to one. Small amounts of ferrous iron usually replace some of the magnesium in dolomite, resulting in the characteristic light brown color of most weathered dolomite formations. Recrystallization also takes place during dolomitization, in many cases producing a sucrosic (sugary) texture that is also characteristic of many dolomites. Because of this recrystallization, primary sedimentary structures, such as current features and fossil remains, are destroyed or at best are poorly preserved.

Geologists do not agree on the origin of the dolomites. Some geologists believe that dolomitization takes place soon after deposition, when the unconsolidated, limy sediments are still in contact with the sea water. Magnesium in the sea water is exchanged for calcium in the sediments by a reaction with the sea water that bathes the upper part of the sediments. Other geologists believe that dolomitization takes place after the limy sediments have been consolidated to limestone, by a reaction with magnesium-rich formation water (connate water) that was trapped in the limy sediments or in associated sandstones and shales during deposition. Another idea is that dolomitization is accomplished by ground water that becomes charged with magnesium from the zone of weathering at the earth's surface. The magnesium-rich ground water percolates through the pores and cracks (joints) in the limestones altering them to dolomite. A few geologists believe that dolomite is precipitated directly from sea water under certain specialized environmental conditions, and that many dolomites are primary in origin, rather than secondary alteration products of limestone. However, the special conditions required for

primary precipitation of dolomite generally are not found in regions of present limestone deposition in the seas, and nowhere in the present seas have geologists definitely established that primary dolomite is being formed. Space does not permit an evaluation of the various theories that have been proposed to explain dolomitization. Suffice it to say that the problem is not solved.

- 0.0 17.7 Leave Stop 3. Continue ahead (north).
- 0.2 17.9 Bear right and then turn left (north) at T-intersection.
- 0.6 18.5 T-road intersection from left. Turn left (west).
- 1.4 19.9 Crossroads. Jog left and then right. Continue west.
- 1.1 21.0 STOP. Intersection with blacktop road. Turn right (north).
- 1.9 22.9 Crossroads. Turn left (southwest) toward Grand Detour.
- 2.3 25.2 STOP. Crossroads at Tealls Corners. Continue ahead (west).
- 0.1 25.3 Wisconsinan drift in a road cut.
- 0.5 25.8 Cross Clear Creek.
- 0.4 26.2 Stony drift in road cut. Many drift exposures occur along the highway for the next few miles.
- 0.7 26.9 St. Peter Sandstone in road cut.
- 1.0 27.9 T-road intersection. Turn left (south).
- 0.9 28.8 Bridge over Franklin Creek.
- 1.1 29.9 Bridge over Chamberlain Creek.
- 0.6 30.5 SLOW. Prepare to turn right. Road cut in till.
- 0.1 30.6 T-road intersection from right. Turn right (north) toward Grand Detour.
- 0.9 31.5 Turn right.
- 0.8 32.3 St. Peter Sandstone in road cut.
- 0.1 32.4 STOP. Intersection with Route 2. Turn right (north).
- 0.1 32.5 St. Peter Sandstone in road cut.
- 0.1 32.6 Cross Rock River bridge. SLOW. Prepare to turn left after crossing bridge.
- 0.2 32.8 Turn left on concrete road to Grand Detour.
- 0.3 33.1 Continue straight ahead on Clinton Street. Do not bear right.
- 0.1 33.2 John Deere Home and Historical Museum on the left. Continue ahead on Clinton Street.

Cross Rock Street.

Cross Broad Street.

Cross Ogle Street.

Cross Illinois Street.

Cross Wisconsin Street.

0.5 33.7 Enter School grounds. Stop 4. Lunch.

0.0 33.7 Leave Lunch Stop. Proceed south on Clinton Street. Retrace itinerary toward Route 2.

0.8 34.5 STOP. Intersection with old Route 2 and Canal Street. Cedar Street. Turn right (west) and continue ahead to small lane at the end of the street. Proceed past sign that says "Private Road, Keep Out." DO NOT ENTER WITHOUT OWNER'S PERMISSION.

0.7 35.2 Stop 5. Small anticline in St. Peter Sandstone. The anticline is exposed on the west bank of the Rock River directly across from the camp area.

This stop is very near the crest or highest part of the LaSalle Anticline, a broad upfold or arch of the Paleozoic bedrock (fig. 2). The LaSalle Anticline is not a single, large upfold but consists of a belt as much as 25 miles wide in which the strata are deformed into a complex series of small, gentle folds (anticlines and synclines) superimposed on the overall structure. Synclines are downfolds of the strata and are the opposite of anticlines.

The small anticline across the river is one of the rare exposures of its kind in Illinois. Erosion (truncation) of the anticline clearly illustrates the principal that older beds are exposed along the crest of an eroded anticline. The beds on the limbs or flanks of the anticline dip (tilt) about 10 degrees away from the crest. The axis or centerline of the anticline trends northwest, parallel to the axis of the LaSalle Anticline. Figure 5 illustrates an anticline and its principal parts diagrammatically.

The LaSalle Anticline is a major structure which extends from Ogle County southeastward across north central Illinois, turns southward along the eastern part of the state through Ford, Champaign, and Douglas Counties, and gradually dies out southward in Wabash County. Like most bedrock structures in Illinois the LaSalle Anticline is not generally evident by its topographic expression at the surface but is known mainly from deep wells (water wells and oil wells), which have penetrated the structure in many places. Careful study of the bedrock exposures along its trend also reveal the presence of the anticline. Along the crest or highest part of the fold older strata are exposed than are found along the sides or flanks (see Geologic Map of Illinois).

Based on studies of the relationships of the sedimentary strata, geologists at the Illinois State Geological Survey have learned much about the time of origin of the LaSalle Anticline and the other bedrock structures in northern Illinois. The movements of the earth's crust that formed these structures began as early as Early Ordovician time about 480 million years ago

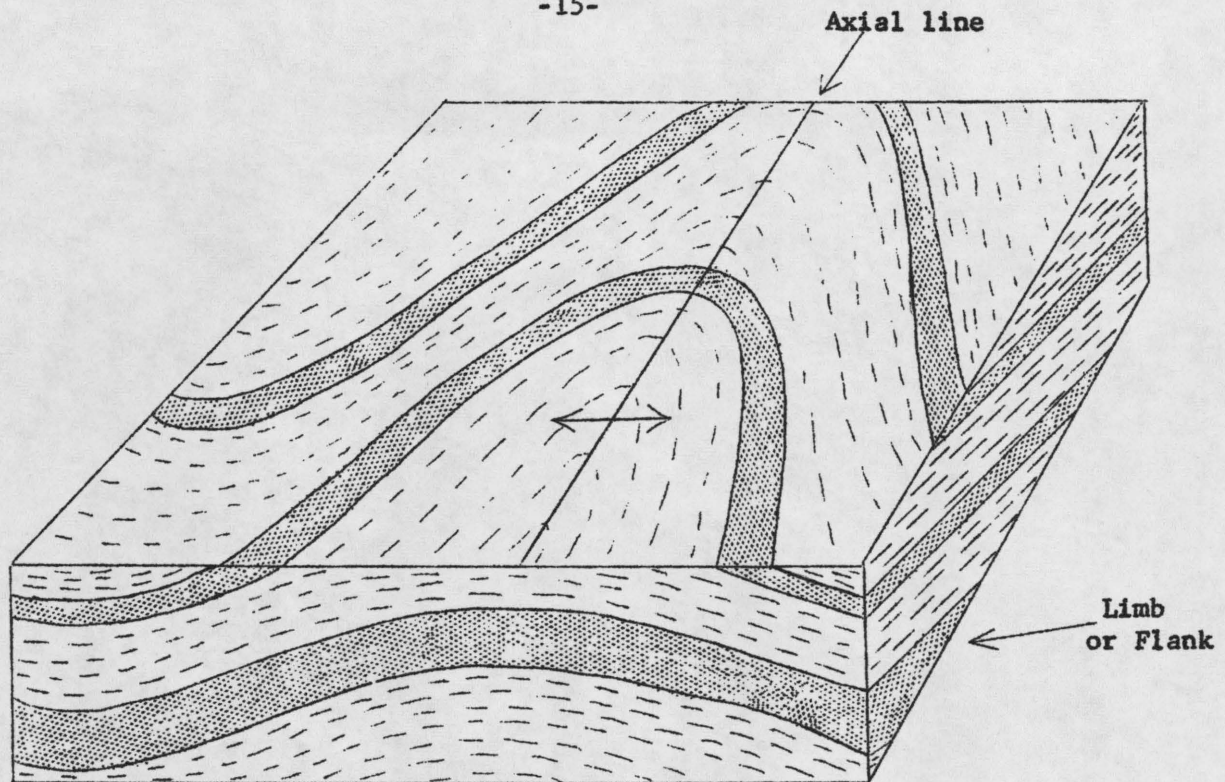


Fig. 5 - Block diagram of a plunging anticline. The axis is tilted down toward the back of the block. The top surface of the block shows the outcrop pattern of the strata that would result by erosion (truncation) of the anticline. The left side of the block shows part of a syncline.

and continued intermittently throughout the Paleozoic Era. Major movements occurred at the close of the Mississippian Period about 310 million years ago and at the close of the Pennsylvanian Period about 280 million years ago. These were times when crustal forces were forming mountains along the eastern margin of North America. These forces were directed toward the northwest, and it is probable that they were also transmitted into the Midcontinent. The rigidity of the thick continental platform greatly resisted these forces, so that the strata in the Illinois Basin were only slightly deformed.

Discussion of the Grand Detour and Glacial History of Rock River

At this point the Rock River bends sharply to the northeast and flows around a large loop before continuing its southwestward course to Dixon. This northward diversion, which was named Grand Detour ("Big Bend") by 18th century traders, was caused by the deposition of Altonian drift (the Grand Detour Esker) which blocked the river's southwestward course. The esker is a short, narrow ridge of sand and gravel that trends northwest-southeast across the abandoned preglacial valley of Pine Creek about one half mile southwest of here (see Itinerary Map). Eskers are the channel deposits of meltwater streams that flowed under stagnant glaciers. The Altonian glacier stagnated early in its history, and several eskers occur in the Winnebago drift in northern Illinois.

Before the glaciers invaded northern Illinois the Ancient Rock River flowed southward from Rockford to the vicinity of Princeton, where it joined the southeastward-trending Ancient Mississippi River (fig. 6). The Rock River Valley lay about 25 miles east of Dixon and was joined by three major eastward-flowing

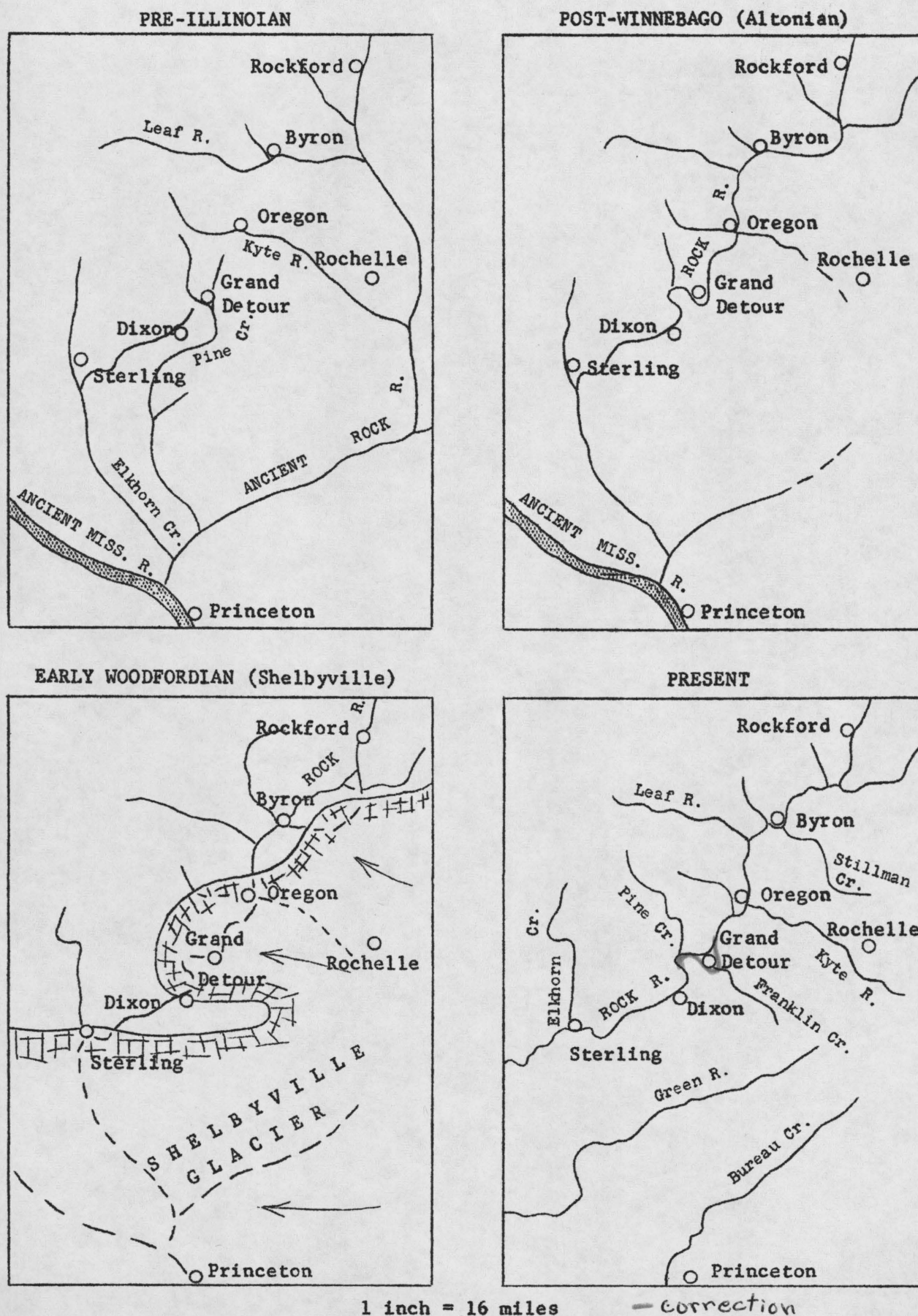


Figure 6. Pleistocene drainage changes of Rock River

tributaries that followed the present valleys of the Pecatonica River, of Leaf River and Stillman Creek, and of Gale Creek and Kyte River. Preglacial Pine Creek flowed southward for about six miles past Grand Detour, and then turned southwestward, passing south of Dixon to join the Ancient Rock River.

Although the region was completely covered by the Illinoian glacier, its effects on the drainage were slight. Apparently the Rock River resumed its pre-Illinoian course after the glacier melted away. During early Wisconsinan time the Altonian glacier also covered the area, and by the time the ice melted away, the Rock Valley south of Rockford had become filled with till and outwash. Behind this drift dam the waters of Rock River backed up in the Leaf River-Stillman Creek Valley until they overtopped the bedrock divide between Byron and Oregon. The waters poured over the divide into the valleys of Pine Creek and Elkhorn Creek, and then flowed southward to the Ancient Mississippi River. The river eroded down through the bedrock divide and produced the deep, narrow gorge that bends around the site of the Black Hawk statue at Lowden Memorial State Park. Because the Grand Detour Esker blocked Pine Creek Valley south of Grand Detour, the river swung northward around the Grand Detour loop and then turned southwestward past Dixon along a tributary of Elkhorn Creek. At Sterling the river assumed the valley of southeastward-flowing Elkhorn Creek. The Ancient Rock Valley south of Rockford was permanently abandoned. The flow of Stillman Creek and Kyte River was reversed, and these streams now flow westward into the Rock River.

The Shelbyville ice sheet, representing the initial advance of the Woodfordian glacier, invaded the eastern and southern parts of the region. Advancing from the east, the ice blocked the Rock River Valley between Rockford and Byron and forced the river westward (fig. 6). Flowing around the front of the glacier, the river cut another deep bedrock gorge, through which it still flows.

The Shelbyville glacier also advanced across the Rock River ^{South}~~north~~ of Oregon, and extended westward through the Green River Lowland into eastern Iowa as a thin, narrow lobe (figs. 4 and 6; see map of Physiographic Divisions of Illinois). The Shelbyville ice permanently diverted the Ancient Mississippi River westward where it cut its present valley. When the glacier melted away, the Rock River was able to resume its pre-Shelbyville course from Oregon to Sterling, but it abandoned its valley from Sterling to Princeton, and cut its present valley southwestward to the Mississippi River.

0.0 35.2. Leave Stop 5. Return to Route 2.

0.7 35.9 STOP. T-intersection with Clinton Street. Turn right (south).

0.3 36.2 STOP. Intersection with Route 2. Turn right and cross Rock River.

0.3 36.5 SLOW. Prepare to turn left.

0.1 36.6 Turn left (south) on blacktop. Do not bear left after turn. Retrace part of morning's itinerary.

0.9 37.5 T-road intersection. Turn left.

1.0 38.5 STOP. T-road intersection. Turn left. CAUTION.

The drift section on the right includes from the top down: reddish post-Shelbyville outwash, gray Shelbyville till, gray and tan pre-Shelbyville silt and loess, and sandy, stony, pinkish Winnebago till. The section is not well exposed but can be dug out to show all of these units, which are deposits of three separate advances of the Wisconsinan glacier.

0.6 39.1 Cross Chamberlain Creek.

1.1 40.2 Cross Franklin Creek.

0.9 41.1 T-road intersection from right. Turn right (east).

1.0 42.1 Stop 6. Weathered St. Peter Sandstone in roadcut.

The St. Peter Sandstone in this roadcut is strongly weathered and deeply stained by iron oxide. An interesting effect of this weathering is the formation of many thin, irregular bands of sandstone that are tightly cemented by limonite. Limonite is an iron oxide mineral that commonly forms in soil zones by the oxidation of iron-bearing minerals. The surface soil here is developed in a thin layer of Wisconsinan till and extends downward into the upper part of the sandstone. Rainwater that percolates through the soil zone carries dissolved iron oxide downward into the sandstone where it precipitates as the limonite bands. Once formed these iron oxide bands are quite stable chemically. The tightly cemented sandstone bands are more resistant to erosion than the uncemented sandstone, so they stand out in relief on the outcrop surface.

0.0 42.1 Leave Stop 6. Continue ahead (east).

1.1 43.2 Stop 7. Exposure of St. Peter Sandstone (Kress Member) and Shakopee Dolomite in roadcut west of Clear Creek.

At this exposure the unconformity or erosion surface below the St. Peter Sandstone can be seen near the east end of the roadcut. The basal, shaly Kress Member of the St. Peter is resting on the Lower Ordovician Shakopee Dolomite (fig. 1).

The Shakopee Formation here consists of thin-bedded, sandy, clayey, cherty, fine grained, brown dolomite. Immediately above the Shakopee the Kress Member consists of reddish-brown clay and shale with thin beds of clayey sandstone. The reddish-brown shale is overlain by variegated red, gray, green, and lavender shale containing fragments of sandstone and chert. The shale grades upward into clayey, light gray to white sandstone. The Kress Member does not occur everywhere at the base of the St. Peter but is highly irregular in its distribution. It also varies greatly in thickness. It is best developed in deep channels, sinkholes, and depressions in the pre-St. Peter erosion surface, where it may be 100 or more feet thick.

The clay and shale of the Kress Member were derived from residual clay and soil which had formed by solution of the Lower Ordovician and Cambrian dolomites during the long pre-St. Peter erosion interval. These materials were washed up by the waves and currents of the advancing St. Peter sea and redeposited in protected areas and low spots on the sea floor. As time passed the muddy sea gradually became clear, and the clean St. Peter sands were deposited.

The pre-St. Peter unconformity has a great deal of relief both topographically and stratigraphically. In wells in northern Illinois the St. Peter Sandstone ranges from as little as 21 feet thick at Prophetstown in Whiteside County to 590 feet thick at Rochelle in Ogle County. Most commonly the thickness ranges from 200 to 300 feet. At many places in northern Illinois and southern Wisconsin the pre-St. Peter erosion cut completely through the Lower Ordovician rocks, and the base of the St. Peter, and the Kress Member where it is present, rests on

strata as old as the Cambrian Franconia Formation (fig. 2). About one mile to the east of here the St. Peter rests upon New Richmond Sandstone and Oneota Dolomite. In the vicinity of Oregon the St. Peter rests upon the Cambrian Potosi and Franconia Formations.

0.0 43.2 Leave Stop 7. Continue ahead (east).

0.7 43.9 STOP. Tealls Corners. Continue ahead (east).

Toward the northeast the itinerary crosses increasingly older strata as it approaches the crest of the Ashton Arch (see Itinerary Map). The Ashton Arch is a large anticline with a length of 80 miles and a width of 17 to 25 miles. The axis of the arch trends north 60° west across northwestern Illinois (figs. 2 and 3). The arch is bounded on the northeast throughout most or all of its length by the Sandwich Fault Zone. A narrow graben and a tightly compressed syncline separate the northwestern part of the arch from the smaller, parallel Oregon Anticline north of the fault. A small syncline also separates the southeastern part of the arch from the LaSalle Anticline. Northwestward the arch merges with the LaSalle Anticline in Lee County and then plunges into the Polo Basin at its western end in Ogle County.

The maximum structural relief on the southwestern side of the Ashton Arch is about 1,900 feet and on the northeast side at least 900 feet. The arch has a broad, nearly flat summit area. The flanks dip gently away from the crest. The steepest dips occur on the southwest flank and are only from 1° to 3°.

2.2 46.1 STOP. Crossroads. Continue straight ahead.

1.1 47.2 Y-intersection. Turn right (south).

0.8 48.0 T-intersection from left. Turn left (east).

1.4 49.4 T-road intersection. Turn left (north).

Stop 8. Cambrian Potosi Dolomite in abandoned quarry. The quarry is located just northeast of the old Prairie View School.

The quarry is badly overgrown with brush and is partially filled with trash, but the dolomite is still well exposed along the south side. The quarry exposes 18 feet of the Potosi Dolomite, the oldest rock unit (about 520 million years) that will be seen along the itinerary and one of the oldest formations that is exposed in Illinois. The Franconia Formation, which is exposed to the north on the Oregon Anticline, one half mile east of Oregon, is the oldest.

The Potosi Dolomite is pure, yellow brown, finely crystalline, vuggy, and thick-bedded to massive. Many of the small vugs are lined with white to pink quartz crystals. These geode-like vugs are especially diagnostic of the Potosi and are used by Survey geologists in subsurface identification of the formation from well cuttings.

The dolomite contains a sparse fauna consisting chiefly of the gastropods Hypseloconus and Scaevogyra and the trilobites Plethometopus and Saukiella.

0.0 49.4 Leave Stop 8. Continue north.

0.5 49.9 Water-filled abandoned quarry in Potosi Dolomite on right, about 400 feet from road. The rock is badly shattered from blasting.

- 0.5 50.4 STOP. T-road intersection. Turn right on blacktop. Washington Grove Cemetery across road on left.
- 0.2 50.6 T-road intersection from left. Turn left (north) on gravel road.
- 0.7 51.3 SLOW. Prepare to turn left.
- 0.1 51.4 Turn left onto lane at mailbox of Wallace R. Karper.

The route here parallels the Sandwich Fault Zone.

A fault is a fracture in the earth's crust along which there has been relative movement of the opposing blocks.

The Sandwich Fault has been traced from a few miles west of Oregon southeastward for about 90 miles into southern Will County. The fault is a large normal fault along which the northern block has moved down relative to the south block. The fault is not a single fracture but consists of a zone up to one mile wide in which the strata are broken by many faults. Relative movements along individual faults range from a few feet to several hundred feet. Just to the east of the field trip area the fault has a maximum displacement of about 900 feet (fig. 2). Figure 7 diagrammatically illustrates several kinds of faults and their principal parts.

- 0.5 51.9 Cross Creek and enter farmyard.

Stop 9. Oneota (Prairie du Chien) and Mifflin and Pecatonica (Platteville) Formations along Sandwich Fault.

Twelve feet of deeply weathered Oneota Dolomite is poorly exposed in the hoglot just west of the barn. Other exposures occur in the creek bank and in tributary ravines farther west. The dolomite is thin-bedded, and the beds appear to be horizontal.

About 300 feet to the north the Platteville formations are exposed in a small abandoned quarry in the hillside at the edge of the field. The Platteville strata are tilted downward to the north at about 10°. The exposed strata are described below.

	<u>Thickness</u>
Ordovician System	
Champlainian Series	Top of Quarry
Platteville Group	
Mifflin Formation	
-Dolomite, pure, nonshaly, weathered to thin beds	2' 0"
-Dolomite, clayey, shaly, thin-bedded; two inches of calcareous shale at base of unit	10' 0"
-Dolomite, pure, medium-bedded; prominent six inch bed at base of unit	6' 8"
-Dolomite, moderately clayey and shaly, thin-bedded	2' 1"

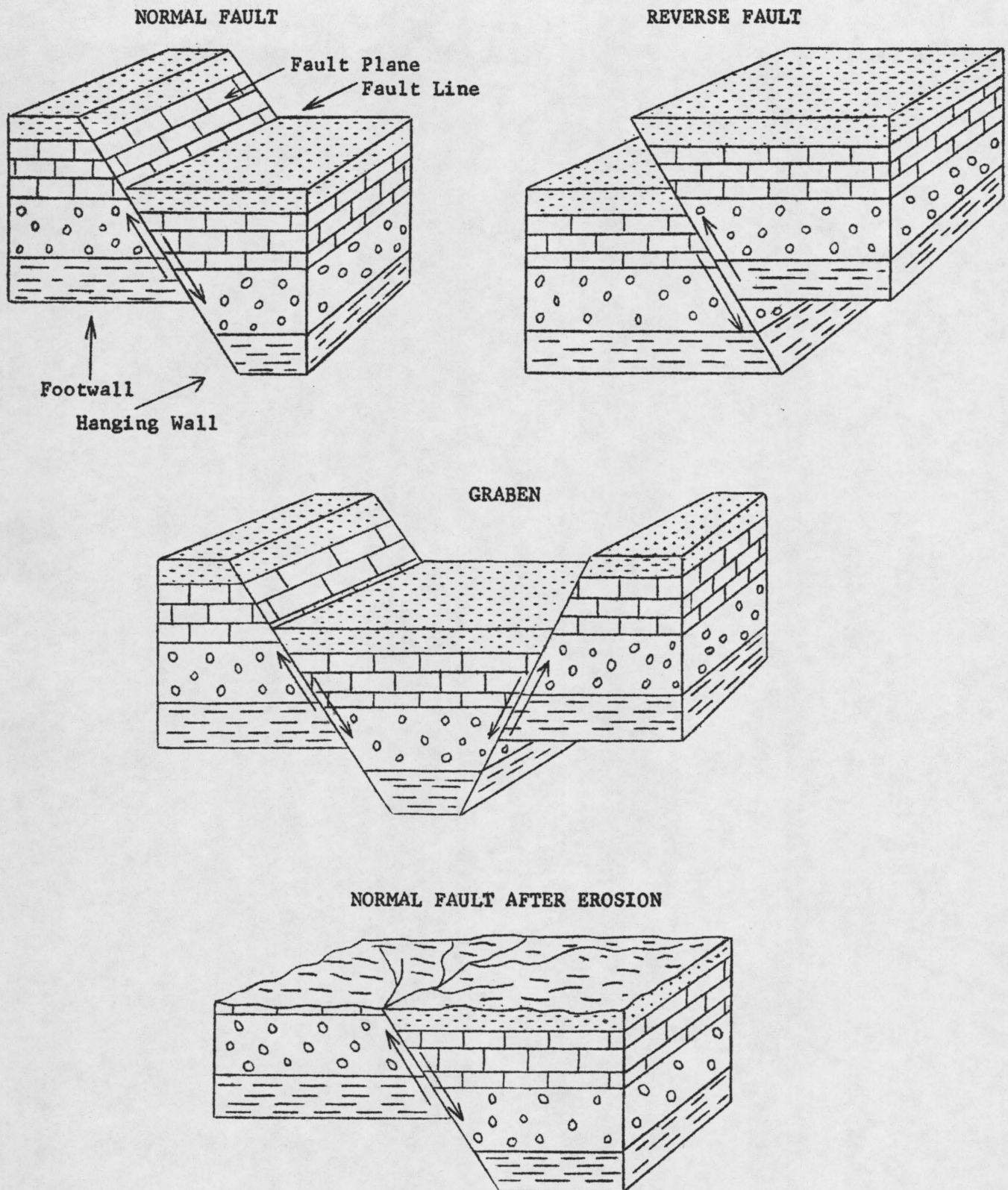


Fig. 7 - Diagrammatic illustrations of fault types represented in the field trip area.

Mifflin Formation (Continued)

Thickness

- Dolomite, slightly clayey, thin-to medium-bedded 1' 9"
- Dolomite, clayey, thin-bedded with green shale partings;
very fossiliferous 3' 3"

Pecatonica Formation

- Dolomite, medium-bedded with weak, wavy shale partings;
a few chert nodules in lower part; a strong ferruginous
(iron-stained) pitted corrosion surface at top of unit 11' 0"
- Dolomite, pure, cherty, thick-bedded 3' 2"
- Dolomite, moderately clayey near bedding surfaces, pure
otherwise, cherty, thick-bedded; a strong bedding break at
top of unit 14' 3"

Bottom of Quarry

The top of the Pecatonica Formation is marked by a pitted bedding plane (corrosion surface) and forms the first prominent bench in the quarry. A sign painted on this surface by a Survey geologist several years ago can still be seen. This corrosion surface represents a temporary interruption in sedimentation after the Pecatonica strata were deposited. It was formed by solution of the calcareous sediments on the Ordovician sea floor before the deposition of the Mifflin Formation. This surface can be traced over a wide area in northern Illinois.

The Sandwich Fault passes somewhere between the quarry and the barn to the south. The creek valley north of the barn is eroded in the fractured rock, a zone of weakness, caused by the faulting. The northward tilt of the Platteville Strata was caused by updrag due to friction between the opposing sides of the fault as they moved past each other. The north side has moved down about 350 feet, so that the Platteville rocks are at the level of the Oneota Dolomite on the south side. The Oneota occurs about 350 feet below the Pecatonica in the north block.

Fossil collecting is very good, especially in the lower part of the Mifflin Formation. This is generally the most fossiliferous formation of the Platteville Group. Characteristic species are:

Arthropods (Trilobites)

Onchometopus simplex

Arthropods (Ostracods)

Leperditella germana

Schmidtella crassimarginata

Brachiopods

Cyclospira aff. C. bisulcata

Opikina wagneri

Pionodema conradi

Skenidioides anthonensis

Strophomena plattinensis

Strophomena winchelli

Bryozoans

Rhinidictya exiqua

Rhinidictya trentonensis

Gastropods

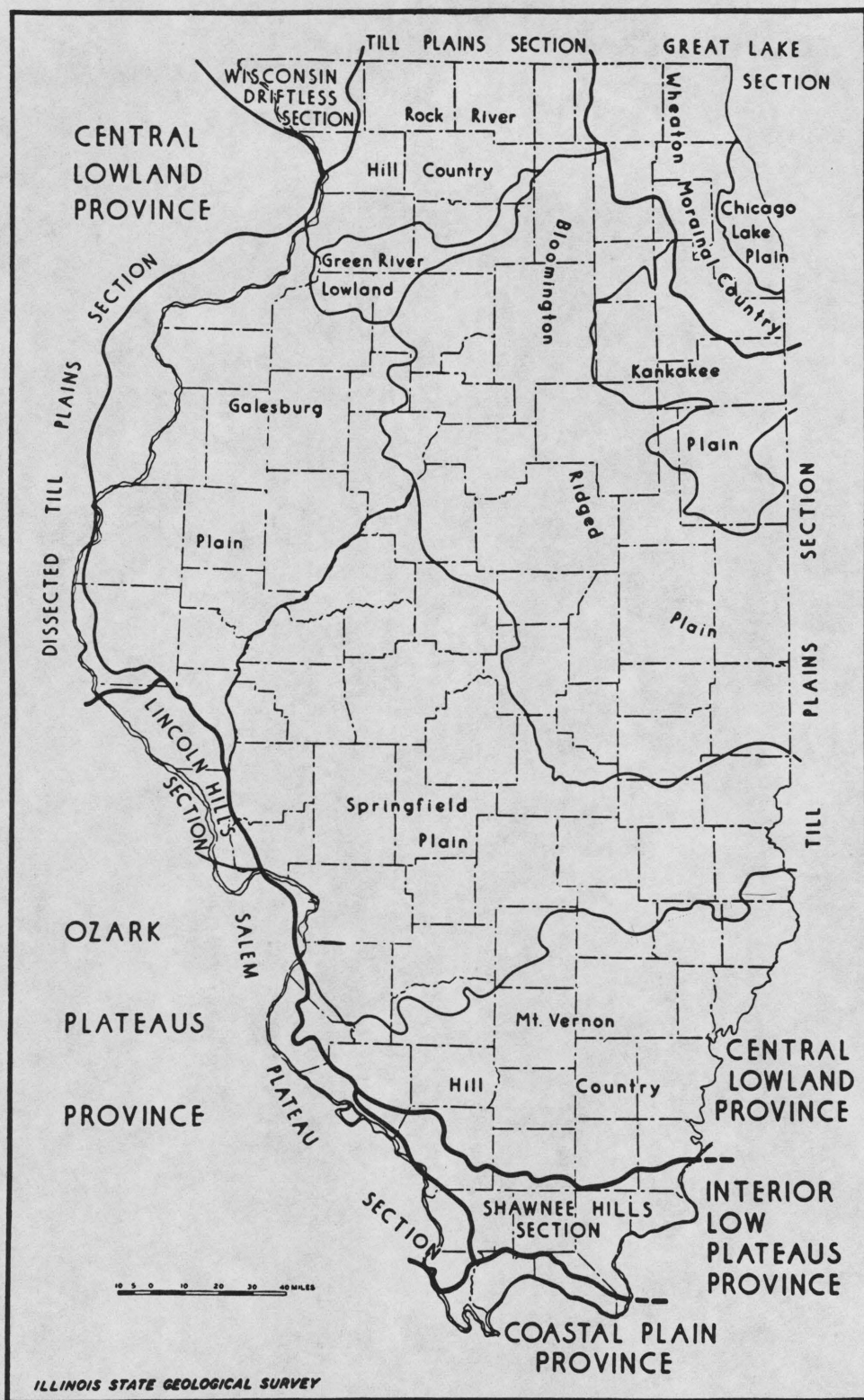
Sinuities rectangularis

End of Field Trip

Drive Carefully on Your Way Home

PROPERTY OWNERS AND TENANTS

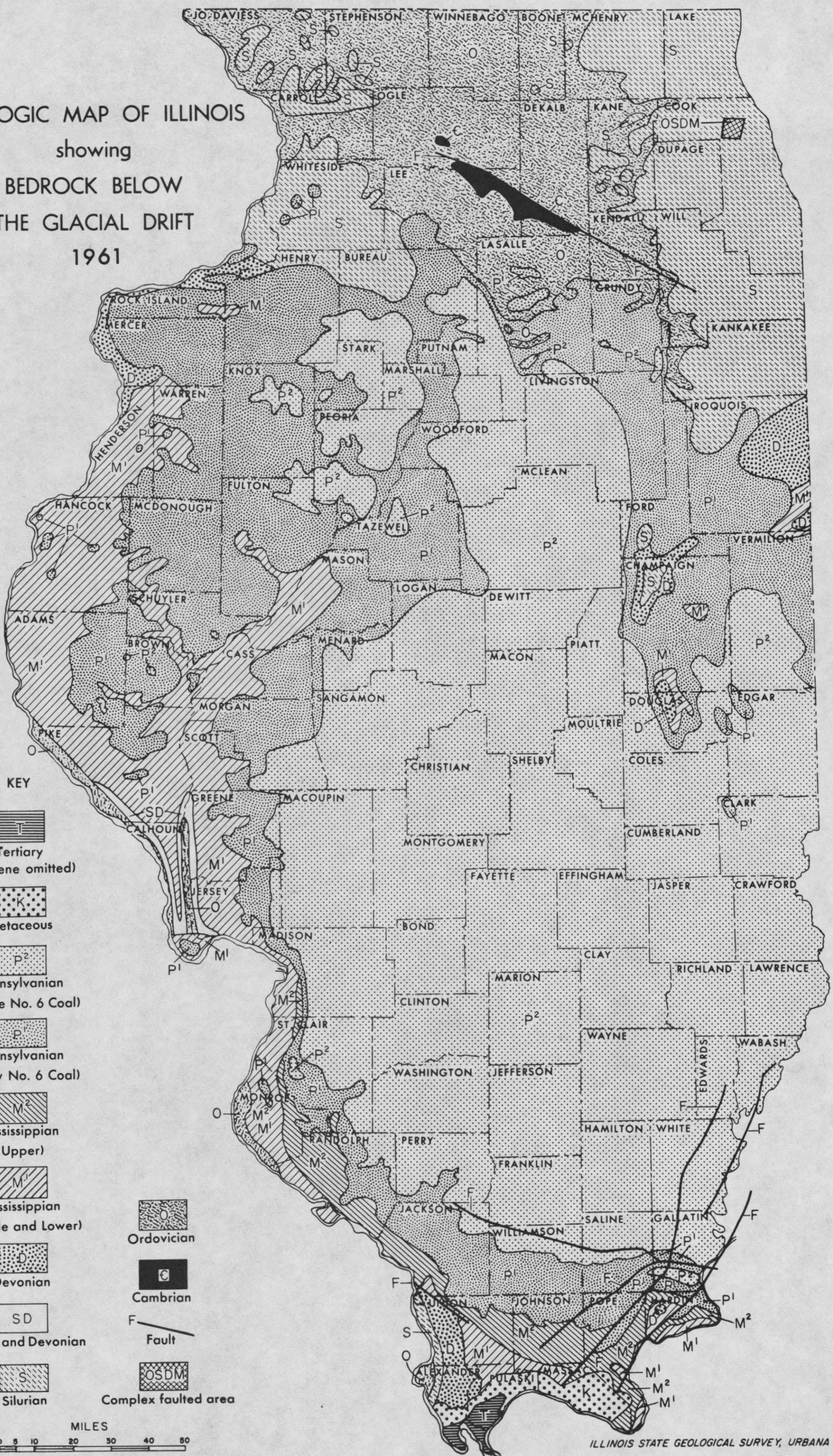
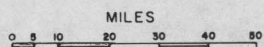
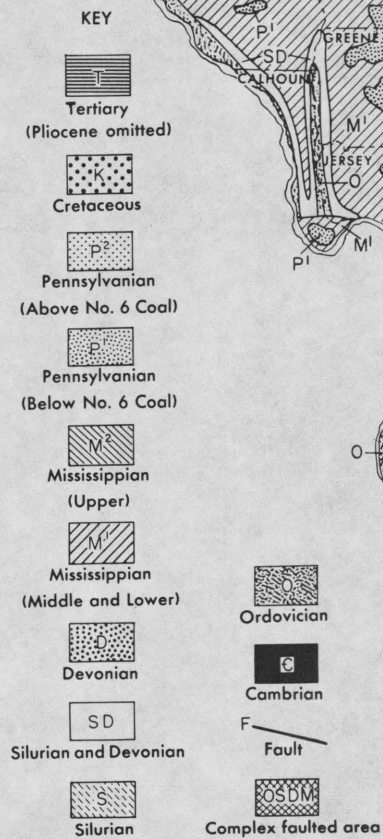
- Stop 1: Land owner - Wilford Lahman, Sterling, Illinois.
Tenant - Jim Cargill, Franklin Grove, Illinois 61031
- Stop 3: Owner-Operator - Mr. Bill Seitz, Oregon Stone Quarries, Inc.,
R. R. 1, Oregon, Illinois
- Stop 5: Land Owner - Mr. Lee M. Jones, R. R. 3, Dixon, Illinois 61021
Residence, Cedar Street, Grand Detour.
- Stop 9: Land Owner - Mr. Wallace R. Karper, R. R. 1, Chana,
Illinois 61015.



PHYSIOGRAPHIC DIVISIONS OF ILLINOIS

(Reprinted from Illinois State Geological Survey Report of Investigations 129, "Physiographic Divisions of Illinois," by M. M. Leighton, George E. Ekblaw, and Leland Horberg)

GEOLOGIC MAP OF ILLINOIS
showing
BEDROCK BELOW
THE GLACIAL DRIFT
1961



ILLINOIS STATE GEOLOGICAL SURVEY, URBANA

